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STUDY ON ENVIRONMENTAL IMPACT THROUGH ANALYSIS OF BIG DATA FOR SUSTAINABLE AND GREEN SUPPLY CHAIN MANAGEMENT

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ABSTRACT

In an emerging global scenario, an effective and smooth supply chain is vital in operations, since thousands of organizations are serving millions of customers. For the organizations, having large product portfolios and serving millions of customers at various locations, getting the right product to the right customer at the right time is paramount. The supply chain ensures this flow from the supplier to the retailer and finally to the customer. Technology is a key role for these operations in general and the data in particular big data, i.e. vast quantities of data used in the supply chain helps, not only increasing the efficiency but also in forecasting the demand and understanding tastes and preferences of customers. Due to climate changes and global warming, customers and companies are increasingly looking at how their carbon footprint is impacting and how can data help achieve a sustainable and green supply chain. These are some of the issues that businesses need to grapple with to withstand relevant and successful. Hence, a study was made to analyze the usage of big data to enhance the environmental impact and green supply chain management.

KEYWORDS: Organization, Environmental Impact, SCM, Big Data & Forecasting

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Original Article

INTRODUCTION

In current technological landscape, data drives virtually all facets of business in all the industries. There is an abundance of information which needs to be streamlined in order to manage critical business functions from finance and accounting to customer loyalty and every department in between. Data is used by companies in many different ways to run its operations at all levels. One crucial part of a company's functioning is its supply chain management (SCM) the journey from sourcing the raw materials by the manufacturer to the finished product in the hands of the consumer along the way it goes through suppliers, wholesalers and retailers [1-5]. Given the main purpose of a company is to make and maximize profits, having a smooth and efficient supply chain is crucial in this regard [6-9]. There are some external factors that influence the supply chain which is discussed elaborately.

Economic Volatility

Due to globalization, emerging economies are growing at a faster pace than established markets. Consumers in these markets are demanding more, causing demand volatility, which requires increased supply chain flexibility.

The tastes and preferences of global customers can vary significantly. Another aspect of this is the volatility of exchange rates and pricing of raw materials, as well as wage increases [10-13].

Consumer Preferences

Consumer tastes and preferences change constantly and vary from one region to another. An optimized supply chain will be able to address these ever-changing preferences. Consumers have become more demanding, which creates more time to market pressure and seek better levels of service delivery. A company that segments its customers depending on their profitability, and as a result, supply chains need to be altered and configured accordingly is one which will be successful [14-17].

Technological Advances

There is an exponential growth in basic computing power and the enormous quantities of data available to companies across the value chain. Companies can make use of "big data" to optimize their supply chains and enhance their profitability by intelligently responding to contingencies. By analyzing big data, they can more easily create supply chains that are green responsive, flexible and intelligent. Data collection process optimization and transparency across the supply chain is the future. Such supply chains are more responsive, but they also operate more intelligently. The convergence of technologies such as mobile, geo-location and digital is a big driver for big-data supply chains [18-21].

Large amounts of data are collected by the companies through consumer transactions and other means. This data is valuable in determining consumer tastes and preferences, forecasting demands not just in terms of existing products, but also possibly in terms of when/if a company may diversify with new products or into new markets. The following are some of the challenges of a data driven supply chain.

Accurately Predicting Customers Needs

A majority of customers will not do business with a brand that failed to meet their expectations. Offering the right product, to the right person at the right time and place is important to gaining and/or retaining customer satisfaction and loyalty. Companies that have a holistic view of their customers understanding personal preferences, creating a unique brand experience will be successful [22-25].

Supply Chain Efficiency

According to Accenture, integrating big data analytics in operations leads to a significant improvement in supply chain efficiency of 10% or greater as cost efficiency and cost reduction are top business priorities [26-29].

Assessing Supply Chain Risk

According to Accenture, 61% of companies regarded as leaders in supply chain management consider supply chain risk management very important. Big data helps assess the likelihood of a problem and its potential impact, and support techniques to identify supply chain risk [30-32].

Supply Chain Traceability

For many companies, traceability is often linked to supply chain risk. Big data helps in improved traceability performance. It helps reduce thousands of hours involved with accessing, integrating, and managing product databases that capture products that should be recalled or retrofitted [33-35].

Reaction Time and Order-to-Cycle Delivery

An important metric of a business success is the ability to quickly and flexibly meet customer fulfilment objectives. Having big data analytics in operations has a significant impact. According to Accenture, this can lead to 4.25x improvement in order-to-cycle delivery times [36].

Big Data

Data reflect all the small, seemingly insignificant details of the modern world. From a review of personal bank accounts, spending habits to larger, more advanced processing capabilities; data evolve and expand with each passing day. Big data are sometimes constrained to digital inputs like web behavior and social network interactions. However, big data also include other points such as traditional data derived from product, transaction information, financial records and information at point-of-sale. This type of traditional data is relatively less compared to the volume of digital data that's now growing at an exponential rate. Companies capture trillions of bytes of information about their customers, suppliers, and operations and millions of networked sensors are being embedded in the physical world in devices such as mobile phones and automobiles. Big data large pools of data that can be captured, communicated, aggregated, stored, and analyzed is now part of every sector and function of the global economy.

The global analyst firm Gartner describes big data in terms of the amount of data, the speed of information generated and flowing into the enterprise and the kind of data available. The possibilities of big data continue to evolve rapidly, driven by innovation in the underlying technologies, platforms, and analytic capabilities for handling data, as well as the evolution of behavior among its users as more and more individuals live digital lives. The biggest obstacles are cost, lack of technology expertise, best practices, and domain knowledge to unlock the value in the data. Companies today are nearly overrun with massive amounts of data about their customers, suppliers, and even potential markets thanks to evolving digital technologies. Making use of all this data is powerful and necessary. An Accenture study stated that of more than 1,000 senior global executives found that, while97% understood how Big Data could benefit their supply chain, only 17% reported implementing any of the findings.

Master Data Managing (MDM)

Master data management refers to the process of creating and managing data that an organization must have as a single master copy, called the master data. Master data includes customers, vendors, employees, and products, but can differ by different industries and even different companies within the same industry. This is typically more important in larger organizations. The bigger the company, the more important the discipline of MDM is, because a bigger organization means that there are more different systems within the company. Master data management involves a number of technology solutions, including data integration, data quality, and business process management. Not every organization will be dominated by the data that they own. Certain industries have much more emphasis on capital assets that they do in knowledge, but even these organizations, data are still growing into one of their largest sources of value across the business.

Forward-moving businesses and their data needs comprise a whole new world that is constantly changing. If businesses want the right kind of data to, for example, create multidimensional views of customers, data integration is a necessary strategy that should align with business objectives. Most organizations have entered the digital realm, where various aspects of business increasingly incorporate cloud, social and mobile as important platforms. Some of the examples

of how big data provide opportunities in the supply chain are as follows.

- Managing supplier relations better and more effectively. Vendors use big data to learn more about their customers, but can also use it to better understand their vendors.
- Big data helps in creating comprehensive supplier profiles, including data from external sources - financial and performance metrics to provide risk managers with real-time analytics.
- Understanding the customers' relationship with the company and how they interact through different channels and offer better product recommendations.

Big Data Analytics

The term 'Big Data Analytics' (BDA) refers to those algorithmic techniques, practices, methodologies, and applications that enable businesses to analyze and make sense of critical business data to help them understand their operations and market. It enables businesses to predict the likelihood an event and take timely business decisions such as meeting the needs of their customers over a sustained period of time. Big data analytics used in two stage logic for systematically finding answers to complicated business problems. The first is about classifying information sources, according to their data structures. The second is about searching for correlations and/or causality among the variables. An example of this is from Dell computers and its customer service solution, dubbed 'Support Assist'. Helpdesk troubleshooting touches many possible information sources to diagnose and fix a problem, examples could be user error, a quality problem, etc. The service information for one customer can amount to gigabytes of data. In this particular case, big data analytics, works by sorting and crunching information with a specific goal in mind and Dell are simply trying to get the customer happily off the phone faster.

In order to avoid potential business opportunities, organizations that create the infrastructure to capture, process, analyze and distribute the data across their supply chains will be able to adjust their capacities and inventories in real time. Given today's complex supply chains spread across the globe, companies must operate to manage logistics effectively, in order to reduce costs and carbon footprints. Supply chains that can sense and respond to demand will help businesses integrate accurate and finely tuned production schedules, procurement plans, staffing, distribution models, pricing structures and marketing and promotion strategy and much more. Big data is an omnipotent, omnipresent topic in successful business models. Like other essential factors of production such as hard assets and human capital, much of modern economic activity simply couldn't take place without it. Every enterprise needs to fully understand big data in the supply chain in order to maintain even a competitive advantage. Unfortunately, businesses that forgo this course will not be able to maintain efficiency at levels necessary to produce the cheapest and most effective products or services.

Big Data in Retail Supply Chain Management

Big data applied to operations and supply chains helps to reduce costs and increasingly create new competitive advantages and strategies for growing retailers' revenue. Big data's potential impact on retail supply chains is huge. Technologies focused on big data can help companies track profitability, on-time delivery and customer feedback in real time. In the realm of retail, big data can help executives in the following.

- Measure the financial impact of decisions, before they are implemented
- Analyze actual versus projected performance, on a real-time basis

- Identify supply chain bottlenecks and find ways around them

Two similar examples of data driven supply chain are Pepsi and Kimberly-Clark. These two companies run big supply chains with products and brands serving a diverse set of customers and markets around the world. The products that these companies are different but both the companies' measure success and failure based on the ability to meet changing customer expectations in price, product, service and quality which depends on the data involved in the supply chain. Data plays a significant role in retail supply chain in the following ways.

Inventory Management

Big data improves retailers' inventory management. Leading retailers improve stock forecasting by combining multiple data points such as sales histories, weather predictions, and seasonal sales cycles. Improved inventory management allows retailers to hold a lower level of stock because supplies are coupled much more tightly with demand, while reducing the number of sales lost.

Distribution and logistics

Leading retailers optimize transportation by using Global Positioning System (GPS) enabled big data tools such as remote reporting of position and route optimization to improve their fleet and distribution management. This helps improve productivity by optimizing fuel efficiency and preventive maintenance.

Supplier Negotiations

In the world of big data, companies can analyze customer preferences and buying behavior to inform their negotiations with suppliers. Price and transaction data are used to focus negotiated concessions on key products. Utilizing big data in this regard is a significant opportunity as the cost of goods sold makes up the largest portion of cost for a retailer. On the other hand, suppliers also understand the importance of data and understanding customer preferences. Those who have access to such data, analyze and uncover insights that strengthen their hand in negotiations with retailers.

Big Data in Forecasting

In today's business and economic environment, companies are faced with the risks of rising interest rates, commodity prices and demand uncertainty which is outside their control. While hedging can provide protection for commodity prices, its effects are only short-term. The benefits of using big data in forecasting are tangible and financially significant. By using big data to sense demand, companies can reduce forecast error. Companies monetize this improvement by reducing inventory while maintaining or improving service levels. Having the product in the right place the first time also avoids expensive shipment cost. Having a control on demand volatility through better data analysis is a very important contribution and decision a company can make to meet its sustainability goals. Piling up of inventory is more than piling up of capital, its accumulation of carbon and water. For multinational companies with large and complex supply chains, the scale of carbon and water tied up in inventory is enormous. Reducing inventory through better forecasting is a significant, one-time reduction in the company's environmental footprint, turning the core supply chain into a sustainability asset for a company's total.

Green Supply Chain Management

Consumers have become increasingly conscious of their carbon footprint and increasingly want insight into the entire production process before they consume a product. They want to know is the process green, what are the

environmental costs, etc. Many consumer goods companies hear about these issues directly from consumers and from social media. The answer to these questions is the use of green supply chains. An obvious benefit of a green supply chain, if communicated to the public is it can become a public relations and marketing plus for the company. If the customers are made aware of a fact such as they are saving a certain weight of packaging material or any other resource that is harmful to the environment, it reflects well on the company. It's a win-win scenario as this reduction in cost is reflected in the bottom line and ensures a degree of customer loyalty. Business activities can pose a credible threat to the environment in terms of carbon monoxide emissions, discarded packaging materials, scrapped toxic materials, traffic congestion and other forms of industrial pollution. Many manufacturers have adjusted their manufacturing philosophies and introduced environmental programs into their organizations through social and environmental responsibility. For example, Xerox and IBM have set up environmental criteria to manage end-of-life (EOL) products or to appraise their value and Sony has required all related suppliers to follow Green Partner Activities since 2001, and has improved its own green management efforts. There are some myths when it comes to a sustainable supply chain management.

The Initiative is Usually Company Driven

As a result of customers being aware of their carbon footprint and environmental issues, their loyalty shifts towards brands and companies that promote a green message. Hence, a company has to use their finances to accommodate and move to a green supply chain while maintaining profitability.

Every Company does Want a Green Supply Chain

The process to convert to a green supply and sustainable chain is a massive task, especially for large multinational corporations. These companies have large product portfolios and are present in hundreds of locations globally. Hence, transforming their supply chain is a time consuming task.

Sustainable Supply Chains are Expensive

A company can achieve a sustainable supply chain by eliminating the expense and eliminating waste and the cost of this waste.

Sustainability only Benefits to the Food Industry

The food industry, agriculture, livestock does benefit from a green supply chain. Other companies in other industries can invest in solar power, and tools and machinery. A green supply chain management ensures integrating environmental thinking into the process such as product design, selection and sourcing of materials, manufacturing process, delivery of the final product to consumers and management of the product after its useful life.

A green supply chain management aims to minimize or eliminate wastages including hazardous chemical, emissions, energy and solid waste along the supply chain. Having a relatively green supply chain plays a vital role in influencing the total environment impact of any firm involved in supply chain activities and thus contributing to the sustainability performance enhancement. With these things in mind, firms develop environmental management strategies in response to the changes of environmental requirements and their impacts on supply chain operations. Taking the basic stages of a supply chain from an environmental perspective, the following steps are to be considered.

Designing of Products

An eco-friendly design approach will ensure that the standards that are set are adhered to. Using proper tools to reduce exhaust emissions at the designing level and selecting essential materials, production procurements and package design. These factors influence primary costs and profits of the new product and affect its environmental impact in each life-cycle phase.

Purchase

A green supply chain includes implementing green purchasing policies by providing technical support to vendors and guidelines for usage of less hazardous materials. Green purchasing focuses on environmentally-conscious practices, including reducing resources, eliminating waste, recycling and reuse

Production

Manufacturing processes consume a lot of energy acquired from burning various natural resources, such as coal, coke and natural gas, and combustion causes air pollution. By adopting a lean manufacturing approach, a company can achieve economies of scale in production. This can be done by using fuel efficient tools and machines and selecting less carbon intensive energy sources. Another aspect in this regard is supplying a greener source of energy and saving energy via new technologies and extending the life-cycle of pollutants and wastes, and increasing the production efficiency via new processes.

Packaging

Packaging primarily involves the materials used. Companies that adopt a green approach use non toxic, mercury free and recyclable materials. Part of this also involves green marketing which emphasizes green characteristics during sale or promotion of products and services, and highlight reduced environmental destruction. A successful approach is to make good use of information and communication technology tools and disclose environmental information of products and services.

Logistics

A green logistics process involves optimizing truck loads and direct shipment to the customer. Some examples and successes of a green supply chain are as follows.

- Pepsi and Coke switched from corrugated to reusable plastic shipping containers for1 litre bottles.
- Texas Instruments reduced its transit packaging budget for its semiconductor business by using reusable packaging systems.
- General Motors reduced disposal costs by $12 million by establishing a reusable container program with their suppliers.

One of the major parts of the supply chain is coordinating the raw materials and components flow efficiently from various suppliers to manufacturing companies. This serves the purpose of converting raw materials into finished products and fulfilling the value expectation of customers. The capability of the supplier is linked to the firm’s ability to produce a product with higher quality and lower costs while meeting the delivery promise. Keeping in mind sustainability, companies pay attention to supply-side practices.

CONCLUSIONS

In this study, the aim of analyzing the usage of big data to improve the efficiency and environmental impact with green supply chain management of manufacturing organizations was carried out. From the study, the following observations were made.

- Many of the companies paid relatively little attention to the social and environmental impact of their business activities and a green and sustainable supply chain management for the past few decades.
- This is the time to begin to change, as companies have come to appreciate the extent to which their supply chains contribute to the level of global sustainability.
- Organizations and civil-society institutions have created a wide array of practices and tools to lessen sustainability impact.
- Organizations that manage their supply chain impact in best position to gain from the boom in consumer spending that is expected to take place next decade and beyond.

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